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COLLEGE OF AGRICULTURE

Soil Drifting and its Control

BY

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INTRODUCTORY NOTE.

This circular was prepared in response to numerous requests from farmers for available information regarding methods of controlling soil drifting. It is unnecessary to discuss the importance of soil drifting, in this introductory note, as the extent of the problem is now widely recognized.

The University Agricultural Extension Committee (Radio Sub-committee) arranged for a series of four fifteen-minute talks on soil drifting, to be given over the University of Alberta Radio Broadcasting Station, CKUA, and the Alberta Pacific Grain Company Station, CKLC, at Red Deer. These were given in February and March, 1932, and this circular was prepared from the notes used by the four speakers.

The following is a list of the speakers in the order in which they gave their talks, and subjects discussed:

F. A. Wyatt, Professor of Soils: Soil Types and Management in Relation to Soil Drifting.

J. Macgregor Smith, Professor of Agricultural Engineering: The Influence of Machinery on Soil Drifting.

R. Newton, Professor of Field Crops: Cropping Systems in Relation to Soil Drifting.

C. C. Gillies, Strathcona, Alberta, Farmer: The Farm Nursery and Shelter Belt.

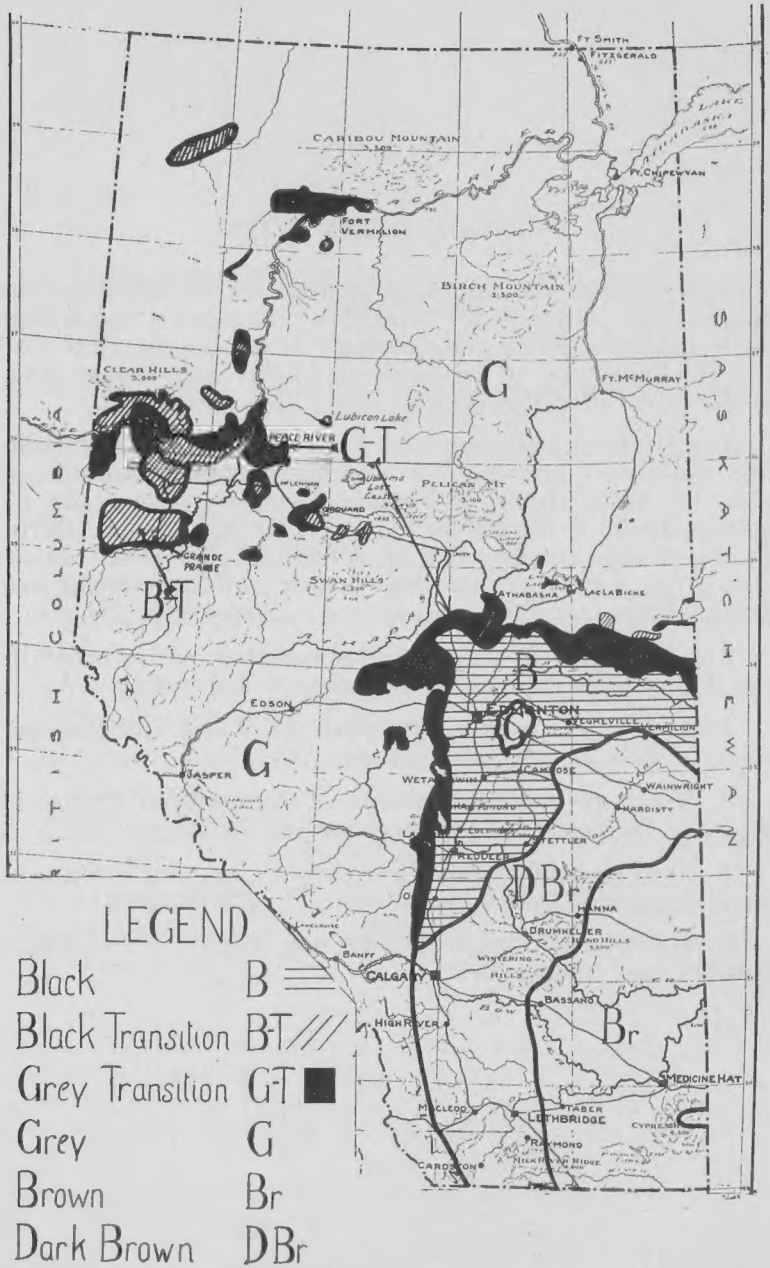

Fig. 1.—Sketch map of Alberta, showing location of major soil belts. (From Univ. of Alta. Bull. No. 21; Wooded Soils and their Management.) Soil drifting occurs most frequently in the southern part of the dark brown soil belt and in the brown soil belt, but it may occur in any of the soil belts in dry and windy weather.

SOIL TYPES AND MANAGEMENT IN RELATION TO SOIL DRIFTING.

(No. 1 in a Symposium of Four Talks on Soil Drifting.)

By F. A. Wyatt.

The time allotted will not permit of a full discussion of the question of soil drifting and control measures. Only brief summaries can be given within the next fifteen minutes.

(1) The ease with which soil drifts is dependent upon a number of factors, such as the size of the soil particle, the condition of tillage, the amount of plant rootlets in the soils, and the protection offered by natural vegetation.

(2) Soil drifting is a direct result of the systems of agriculture practised primarily in connection with a straight grain growing policy.

(3) We may predict with a large degree of certainty that soil drifting will become more serious with the more extensive development of our agricultural areas unless the farmer can be made to realize that he must take the necessary precautions to prevent the drifting of soil.

(4) To completely control soil drifting may require the use of different methods for the different areas. Soil drifting will continue to be a very great menace during some years whereas no damage will result from the drifting of soil in other seasons. We must farm every year in such manner that we will be prepared to control soil drifting. During the seasons when no damage occurs from soil drifting it is very easy for us to forget that seasons will recur when the utmost precaution is necessary if we are to prevent serious damage from this cause. While soil drifting is a menace it can be controlled.

(5) Methods for the prevention of soil drifting are suggested if we take time to consider the conditions imposed by nature before the soil was cultivated, and also, the change in these conditions as a result of the cropping systems employed by farmers.

In certain districts with apparently similar climatic conditions there are areas which suffer more severely from soil drifting than adjacent areas.

I have just said that the ease with which cultivated soils drift is dependent upon a number of factors such as size

of the soil particle and the proportions of the different soil particles, the condition and amount of organic matter present, and the condition of cultivation.

All soils consist of mixtures of soil particles of varying sizes in varying proportions. The finer the soil particle and the higher the percentage of minute soil particles the greater will be the ability of the soil to lend itself to natural weathering conditions and the more difficult it will be for soil drifting to begin. On the other hand, the larger the soil particle and the smaller the proportion of clay in the soil the more easily will the soil begin to drift.

The larger clay particles are about 1/5000 of an inch in diameter, whereas the sand particles vary from 1/500 to 1/10 of an inch in diameter. The sandy soils are loose and have an individual grain structure—this permits them to start blowing easily when dry. The loams have the ability to form clods or compound granular structures. These clods or granules are held more firmly in the form of granules when dry than when moist—just the reverse of the sands.

The loams, even under intensive cultivation tend to retain their complex granular structure—thus they are the last soils to start drifting. The clays also form granular structures, but intensive cultivation produces a certain amount of individual grain particles which permits blowing at an earlier stage than in the case of loams.

Intensive cultivation tends to reduce the complex granular structure and to encourage drifting. Cultivation of this kind nearly always accompanies the straight grain growing system, and with such a cropping system, intensive cultivation is absolutely necessary, in order to control weeds, to prepare available plant food, and to conserve moisture. Such cultivation speeds up the rate at which organic matter is decomposed. The amount of organic matter, especially if it contains a fair proportion of fresh plant rootlets, is the greatest single natural factor in preventing the drifting of cultivated soils after the natural protective covering has been destroyed.

Soils in their virgin condition are protected from the winds by the vegetative covering of grass and trees and the firmness with which they are held by the plant roots. It is only in isolated cases of extremely light sandy soils that soil drifting occurs before the soils have been broken as, for example, in the case of certain dune areas.

It is only after the soil in its natural condition has been disturbed by man that soil drifting can take place to any great extent, and since cultivation—intensive cultivation in most

cases—is not only desirable but necessary, it remains for the farmer to provide the remedy for soil drifting. At a later point I shall suggest these remedies, but at the moment I want to say a few words about the extent of damage caused by soil drifting, and if possible give you some idea of the value expressed in terms of "loss of fertility due to soil drifting."

Soil drifting occurs from Texas to the great expanses of the Peace River country and from the Rocky mountains to Manitoba. It is found in the great basin areas of the Rocky Mountains, and in certain sections of some of the foreign countries. It rarely approaches a serious condition in districts of high rainfall. It becomes serious only when high winds pass over dry soil which is in a fine state of cultivation.

What does soil drifting mean to you in term of loss?

You are familiar with the appearance of fields in your own vicinity and other vicinities. You have a very good idea of the value of the total loss of one or more crops which were cultivated and seeded upon several consecutive occasions during the same year—and later, probably, summerfallow was the only alternative remaining. I need not dwell upon these things which are familiar to all of you. But let me express in terms of dollars and cents the loss in potential plant food from an acre of land which has suffered severely from soil drifting.

Let us assume that 1 inch of soil has been removed from the farm. This amounts to from ¼ to 1/6 of the soil which the farmer plowed. It is the very best part of the soil because it consists of the finer material and the organic matter. It would contain in the black soils belt of Alberta:

300 pounds of phosphorus,
1500 pounds of nitrogen,
15 tons of organic matter.

To replace the phosphorus would require about 1600 pounds of treble superphosphate costing from $40.00 to $50.00 (car load lots) and sufficient for twenty to thirty normal yearly applications of this fertilizer. The phosphorus thus lost would be equal to the amount removed from the soil by twenty crops of wheat each yielding 50 bushels per acre.

It would require 160 tons of farm manure to replace the nitrogen or 5 tons of sodium nitrate. Any way you figure—it would require from $150.00 to $250.00 worth of commercial fertilizer to replace the nitrogen lost from one acre by the removal of a layer of soil one inch deep.

The above figures are for the most fertile soils in Alberta, but forty per cent. of these figures would represent conditions in any of the less fertile areas in Alberta.

Let us now pass on to the question of measures for the control of soil drifting. In this connection I cannot do better than summarize the statements which we have made in some of our soil survey reports as follows:

All soil types appeared to drift provided they had been cropped for a number of years and happened to be in a fine, loose, dry condition when swept by strong winds. Some types drift earlier after breaking than others. Some likewise drift more severely than others. The sands start very shortly after breaking, whereas a number of years may elapse before the finer types are affected. The lighter types and the heavier types of soil are more severely affected than those of intermediate texture. Some parts of the sand areas are so loose that they have drifted even before breaking.

There are very few districts in which soil drifted before it was brought under cultivation. The sod was full of root fibre, and the grass covering the surface held the soil.

The summerfallow has undoubtedly been directly responsible for the menace of soil drifting, but we can not dispense entirely with it; thus it would seem that we are justified in somewhat modifying it.

The longer we cultivate our soils the greater will become the tendency for them to drift, but fortunately by somewhat modifying our present system we can lessen and finally minimize this menace. Discussions of the ways of controlling soil drifting have elsewhere occurred in the printed press, but it is not out of place to briefly mention a summary of these control measures as follows:

(1) Regulate time of plowing so that the soil is moist when plowed.

(2) Leave the surface rough; beware of implements which pulverize the surface soil.

(3) Control weeds on summerfallow by using such implements as the rod weeder, duckfoot cultivators, etc., which do not disturb and pulverize surface soil.

(4) At critical time keep surface soil ridged at right angles to prevailing wind by using lister, plow; even springtooth harrow may do, provided the surface soil is moist.

(5) Spread manure on the spots most likely to start blowing.

(6) Alternate strips of crop and fallow.

(7) Use summerfallow substitutes such as corn, sunflowers, sweet clover.

(8) Use systematic rotations, including a certain amount of grass crops, and keep some livestock, thus maintaining the fibre in your soil.

(9) Include a fall cereal such as rye in your rotation.

(10) Do not have too large areas of fallow in one field or in adjacent fields.

(11) Plant more trees for wind breaks.

(12) Irrigate as much land as possible.

Summary.

(1) Some types of soil drift more easily than others.

(2) The light sands and the heavy clays are worse in this respect than are the intermediate loams.

(3) All soil types will ultimately drift unless preventative measures are employed.

(4) Drifting will always be a danger in each of the various soil belts. It can be more easily prevented in the park belt and the wooded belt than in the dry plains belt.

(5) Summerfallow has undoubtedly been directly responsible for soil drifting, but we cannot dispense with it; thus it would seem that we are justified in somewhat modifying it.

(6) If we are to successfully reduce and control soil drifting it is necessary for us to realize at all times that the worst soil drifting invariably follows intensive cultivation and the bare fallow.

(7) Some seasons will be very bad for drifting, others will cause no trouble. This condition can be expected. We must be prepared to farm every season as though it were going to bring soil drifting.

(8) The longer we cultivate our soils the greater will be the tendency for them to drift.

(9) In the unsettled wooded areas sufficient wind breaks should be left to prevent the starting of soil drifting.

(10) Soil drifting is a provincial problem and must be seriously considered by all farmers. A few farmers in each district are not sufficient to control this menace. It requires the united efforts of all farmers.

THE INFLUENCE OF MACHINERY ON SOIL DRIFTING.

(No. 2 in a Symposium of Four Talks on Soil Drifting.)

By J. MACGREGOR SMITH.

The first address of this series dealt with "Soil types and management." Tonight "The influence of machinery on soil drifting" will be considered.

Soil drifting has become a very grave problem in many parts of western Canada. Last year the problem was a very serious one in the northern part of Alberta, as well as in the south.

Let us consider briefly some of the historical factors that have a bearing on the subject. The process of plowing has always seemed slow even to those who lived long before the word "mechanization" was connected with things agricultural. An endeavor to speed up this slow operation resulted in experiments being made with screw pulverizers of various kinds, and of rotary harrows. In the late seventies the disc harrow became quite a common implement, a shipment of 10,000 being made to the far western states in 1878. The following year saw 30,000 more in use. The cutaway type of disc was introduced about 1892. The disc harrow has no doubt been the cause of a good deal of trouble by pulverizing the soil too much. It must be used in its proper place, and more will be said on this point later.

The early settlers of western Canada had to kill the native sod if they wished to grow other crops. To do this the sod was skimmed off with a breaking plow and allowed to rot. Then in August a deeper furrow was taken and the rotted sod plowed under in the process of "back setting." The second plowing operation was eliminated with the introduction of the disc harrow. The implement was valuable for this purpose, and for many years it rendered a great service to the agricultural practice of the country. The late Angus Mackay of Indian Head is credited with the introduction of the practice of summerfallowing by which sufficient moisture could be held in the soil to practically make sure that there would be a sufficient supply available for the crop to be grown the following year. The disc harrow, being available, was naturally used to cultivate the fallow. The drag harrow was used immediately after the plow to make the elusive "dust mulch" which was supposed to prevent the evaporation and loss of moisture from the surface. If there had been any sub-surface water to rise to the surface this would have been a worth while

precaution, but the water table was in most cases very low. These practices, together with the continued growing of grain crops which resulted in little fibre being returned to the soil, had the effect of gradually bringing the soil into a very fine state of pulverization, varying to some degree in various soil types. The wind then began to take a heavy toll from some fields. As far as the conservation of moisture is concerned it is now an accepted fact that the only excuse for tilling the soil at all is to kill weeds.

Implement companies have been quick to respond to any demand for special tillage tools which seemed to have any special advantage in the work of summerfallowing, and which would keep the soil from drifting. The one way plow of the disc type, sometimes called the "Wheatland Plow", the "Harrow Plow", the "Tiller Combine", etc., is in this class, and more will be said about this implement.

Strip farming in the south has overcome many of the hazards of soil drifting, but this topic does not fall within the scope of my subject, except in one point, the width of the strips and the size of the implements should be correlated to some extent.

During the winter season in some sections soil drifting is a serious problem when there is little snow. However, men in such sections have entire confidence in their ability to control it by starting to cultivate on the windward side of the field that is actually blowing. This is a most hopeful sign.

The one way disc plow: This machine cuts, turns and mixes the stubble with the soil. It leaves the field level but a little rough on top. It mixes the stubble with the soil, and by leaving a somewhat rough and cloddy surface asssists in preventing soil blowing. Correspondence with many farmers in southern Alberta confirms the statement that this implement is filling a real place in the farm practice of that section.

Some excerpts from the letters that farmers sent in will be of interest at this point, and now I quote: "In answer to your inquiry as to the use of the wheatland plow this season, I did all my summerfallowing with it. First I double disced early, after the weeds started, then I plowed. After that I simply cultivated and left the land well ridged up for the winter.

"Last spring was very trying on the land, and drifting was very bad in this neighborhood, many fields being blown out. I had no trouble, and took off a full crop.

"Yes, I think this plow cuts expense in half, and where properly handled reduces drifting to almost the vanishing point."

In a second reply the correspondent says in part: "As regards cost of summerfallowing, I can truthfully say that it does cut the cost of this operation in two. But as to the soil drifting problem, I am inclined to think this to be overemphasized when there is a *light or very short*, or burnt over stubble to deal with as summerfallow. Under these conditions a duckfoot is much superior to the wheatland or moldboard plow. On the other hand, where there is a *long stubble* the wheatland does excellent work and very little drifting occurs; nor do I think it would drift if a disc or duckfoot were used on this type of soil and stubble.

"The spring of 1931 was praticularly windy in this district, and in my judgment those fields which were wheatland plowed blew worst, providing they had not a good quantity of straw incorporated in it."

A third goes on to say: "My opinion is that this implement will prevent soil drifting only if there is lots of straw to be worked in. A combine stubble is ideal, especially if a straw spreader is used. If the stubble is burned off, as it sometimes is done in the spring, or if one is summerfallowing land on which there has been a light crop, I think it is risky to use where there is a tendency for the soil to drift."

The fourth reply reads in part as follows: "I used it to disc 70 acres of wheat stubble before sowing this last spring. I am well satisfied it is far better than the disc harrow or the duckfoot cultivator for preparing stubble for crop. I used the disc harrow for some and also the cultivator, and either did not do as good for killing weeds as the wheatland plow. I also used it for my summerfallow this year. I think that land summerfallowed with it will drift as bad or worse than the moldboard plow, unless there is a heavy crop of stubble to work up with the soil, as it leaves the soil fine."

And lastly we read: "I had no soil drifting caused by the wheatland plow. I had 200 acres in crop on the half section I live on. About 100 acres drifted. The land is east and west, and the east end drifted, caused by my neighbor having land on both sides of this crop, which he disced with a double disc, and it drifted over my land. My neighbor east of me lost nearly all his wheat on his quarter section, but the rest of my land did not drift. This is to show what improper cultivation can do, or by using the improper implement at the wrong time, etc."

Montana to the south has a similar problem, and a letter from the State College has this to say: "There seems to be a great deal about the soil physics which we do not under-

stand. We have been very emphatic in condemning any rotating tools which have a pulverizing effect. We have also been preaching the gospel of a cloddy fallow which may be best established by the use of a duckfoot cultivator. However, this last season we had a considerable area which had been cultivated with the rod weeder and was perfectly smooth. However, it did not blow, which indicates that there is something peculiar which we do not seem to understand. Consequently, based on past experiences, we are inclined to believe that the two most satisfactory tools to use are—one where the duckfoot cultivator is used straight through the season, and the other where the one-way disc is used the first time over and the rod weeder for subsequent cultivations. In the first case we get a ridged and cloddy condition. In the second case more of the stubble lies on the surface of the ground, which perhaps is what retards the blowing.

"Our Agronomy Department is investigating, as I believe I said in a previous letter, and we will most certainly keep you informed of developments.

"I think perhaps the people east and northeast of Lethbridge have progressed as far in this direction as any group of farmers anywhere. It appears now that strip farming is the only method of controlling soil blowing when it assumes such proportions as it did during the past year. Under our conditions the blowing had been pretty well controlled up to 1931 by the use of a cloddy mulch on the fallow which was usually obtained by using the duckfoot cultivator when the soil was fairly wet. Cloddiness did not prevent soil blowing in 1931, and as far as we have been able to learn no method of strip farming withstood the winds of the last season."

Coming from an outsider who is thoroughly familiar with our problem of soil drifting such a statement is most encouraging.

The experience of the central states that have had this problem seems to indicate that soil blowing can be controlled by mechanical means, and that the work must be done immediately while the wind is blowing and moving the soil in the majority of cases.

The next implement to consider is the disc harrow. The disc harrow has served as a light tillage implement for shallow fall discing, for spring discing on stubble for crop and for spring tillage for crop on summerfallow on heavy soils. Also for the first and often second third operations on summerfallow.

The double disc is satisfactorily used where shallow tillage is required, except in heavy clay soils where the rear gang clogs with sticky soil.

The single disc is used in all areas where double discing is desired by lapping half the cut.

The efficiency of the disc harrow depends largely upon the sharpness of the disc and the weed growth upon the land. Considerable judgment should be exercised in its use if soil drifting is to be avoided.

There is a tendency even in the park belt to disc too much. In a dry year, for example, when there is a crop failure, the crop is usually plowed down and then disc harrowed. This of course is simply pulverizing the soil and getting it into the optimum condition to encourage blowing. It is also quite a common practice in the spring for men to get out on the land and disc, and then when they are asked why they do disc they do not seem to have any very clear idea excepting that they wanted to get on the land early.

Stiff Shank Cultivator: The stiff-shanked duckfoot cultivator is an implement of considerable merit in districts where the disc harrow encourages soil drifting. Its outstanding point of merit in weed control is the completeness of cut obtained. The efficiency of the field cultivator depends largely on the condition of the shovels in regard to sharpness and scouring.

In connection with a packer we find that while this implement packs the soil around the seed, it very often pulverizes the soil and the top blows, in some cases with serious results, while in others very little harm is done.

A manure spreader is an implement which is overlooked to some extent, because if manure is spread on the knolls it will sometimes help a great deal to prevent blowing. One very important thing for those who have the problem is to do a little experimental work themselves and observe carefully the results.

The problem under discussion is a very vital one. We need the co-operation of all interests concerned.

I shall be very glad to hear from any farmers who have suggestions to offer in connection with the influence of machinery on this problem, so that information may be passed on.

Plate I, Fig. 1.—Sand dune advancing from nearby cultivated field. (From Univ. of Alta. Bull. No. 11: Soil Survey of Macleod Sheet.)

Plate I, Fig. 2.—Soil drifting in silt loam area. (From Univ. of Alta. Bull. No. 11: Soil Survey of Macleod Sheet.)

Plate I, Fig. 3.—Soil drifting in boulder clay loam area. (From Univ. of Alta. Bull. No. 11: Soil Survey of Macleod Sheet.)

Plate II.—Showing how the one way disc plow mixes the stubble with the surface soil, leaving a well-protected surface.

Plate III, Fig. 1.—Cultivating to leave the surface in a lumpy condition, and ridged at right angles to the prevailing wind.

Plate III, Fig 2.—Plowing, packing, and seeding with the press drill in one operation. This is a good method of handling spring seeded stubble land, as it insures quick germination and leaves the land in a ridged condition.

Plate IV, Fig. 1.—Farm buildings protected by wind-break of trees. (From Univ. of Alta. Bull. No. 16: Soil Survey of Sounding Creek Sheet.)

Plate IV, Fig. 2.—Showing wind-break on Lethbridge Experimental Farm.

CROPPING SYSTEMS IN RELATION TO SOIL DRIFTING.

(No. 3 in a Symposium of Four Talks on Soil Drifting.)

By R. Newton.

You have already heard two talks in this series on soil drifting. Last week, Professor Macgregor Smith pointed out how the breaking up of the native prairie sod and its gradual reduction to a powdery condition by tillage repeated year after year, sometimes with unsuitable implements, had brought upon us the soil drifting problem. He advocated the use of implements which kept the soil lumpy on top and kept the stubble on or in the surface. A week earlier, Professor Wyatt showed you how the type of the soil was related to the problem: light sandy soils, at the one extreme, and heavy clay soils at the other, blow more readily than do loams of an intermediate type. It follows therefore that the method of handling soils to control drifting will vary somewhat with the soil type. Still more will our methods vary with climatic conditions, since climatic factors are the direct cause of drifting. Tonight I shall discuss briefly how we may modify our cropping systems to meet the problem.

Drought and wind are the immediate causes of soil drifting. Obviously we cannot prevent the operation of these factors directly, but we may do much to meet them indirectly. Our plant breeders are working hard to produce more drought-resistant cereals, grasses and other forage crops, which may enable us to keep the ground covered better in dry seasons. A crop failure, which leaves the land bare, is of course a direct invitation to soil blowing. The production of a really winter-hardy winter wheat, satisfactory in yield, quality and other important characteristics, would enable us to keep more of the land covered at the critical times, namely, the fall and spring months in central and northern Alberta, to which we must add the winter months in southern Alberta. This also is an important object of plant breeding work now in progress. But plant breeding is a tedious business, the fruits of which are apt to be long delayed. In the meantime, we must adopt such measures as are immediately available, and it is to these that I wish to direct your attention now.

Nature's cropping system is simply to keep the prairies covered with grass, and probably this must still be regarded as the only absolute "cure" for soil drifting. Where practically straight grain farming is practised, we may have to be content with reasonable "control" rather than cure of the trouble. We

might, however, make more use of grass than we do, at least in some districts. Brome grass and western rye grass are quite highly drought resistant, and the fibre which they add to the soil will help a great deal to bind it together even after the sod is broken.

In this connection you will be interested to get an idea of how much fibre a grass or legume sod adds to the soil. A brome sod just one year old, plowed to a depth of 6 inches at Edmonton in 1928 was found to contain in that depth a dry weight of roots and stubble equal to about 2¼ tons per acre. An alfalfa sod the same age contained about 3 tons of dry roots and stubble per acre. Similar plots were plowed in 1930, when the sods were three years old. By then the brome residues had increased to 3½ tons per acre in the top 6 inches and the alfalfa residues to 4 tons. The alfalfa thus added a greater weight of fibrous material per acre than did the brome grass, but we must remember that for the purpose of binding the soil together the grass residues are, pound for pound, more valuable than alfalfa or sweet clover residues, because the grass residues are much more finely divided.

The adoption of a cropping system in which a moderate acreage is seeded to grass each year, so that all parts of the farm will have a season in grass every 6 or 7 years, will help a great deal to mitigate the evil of soil blowing. It is of course not a complete cure, since broken land is always dangerous in dry weather unless protected by some other measures, such as strip farming, but a soil well supplied with fibre is decidedly easier to control.

The use of intertilled crops as fallow substitutes, or of fall-sown cover crops on the fallow, affords good protection wherever the rainfall is sufficient to permit of these practices. In the Claresholm district some farmers are successfully using a scheme in which they plant part of the fallow to corn in double rows, 3½ feet apart, with a space of one drill width between pairs. The whole of the fallow, including both the spaces between the pairs of corn rows and the remaining bare part is seeded shortly before the corn harvest with about 10 lbs. of oats per acre. The oats make enough growth to hold the soil in place over winter, and since of course they are killed by the frost, they do not interfere with next season's crop. It should be added that all crops are drilled at right angles to the prevailing winds to obtain maximum protection.

The drawback to all such fallow substitutes or partial fallows is that a growing crop uses up moisture, and therefore partly defeats one of the main purposes of a fallow, namely,

the storage of moisture from one season to the next. However, a fall-sown cover crop, such as the cover crop of oats just described, does not reduce the amount of moisture remaining in the spring to the extent which might be expected. The protection given to the surface of the soil by the mat of vegetation cuts down the loss of moisture by evaporation, thus compensating in no small degree for the use of moisture by the cover crop itself.

The growing of winter rye gives complete protection to the soil during the period when blowing is usually worst. This crop, however, must be used with caution on wheat farms, since its tendency to volunteer makes it especially difficult to avoid getting the two crops mixed.

For the straight grain-farming districts of southern Alberta, where a black fallow is considered essential, the only safe cropping system seems to be that known as "strip farming." The Monarch district is perhaps the classical example of how a region apparently doomed to destruction by soil blowing has been saved by the general adoption of this system. It consists simply of strips of summerfallow 10 to 20 rods wide alternating with strips of grain of the same width. The narrower strips are used where the blowing conditions are more severe, but the wider strips are more usual. If it is desired to fallow the land every third year rather than every second year, the strips of crop are made twice as wide as the strips of fallow. The exact width of the strips may be adjusted to suit the farm implements which are available. The strips of course run north and south.

The essential feature of strip farming is that there are no broad stretches of fallow, in the direction of the prevailing winds, to gather huge clouds of flying soil particles. These clouds roll up like snowballs when they are given a chance. It will thus be apparent that to be fully successful, the system must be adopted by the whole community. A farmer who is himself taking all precautions to prevent soil blowing may have his fields buried by soil from the farm of a neighbuor who is not so careful.

There are of course some disadvantages to strip farming. The system does not lend itself well to mixed farming, as it increases the difficulties of fencing stock. Sheep cannot be run on the fallow as an aid in keeping down weeds. Moreover, weeds tend to accumulate along the edges of the strips; it may be necessary to use modified implements and to sacrifice the marginal drill-row of standing grain in order to clean them out. Again, since the strips are permanently located,

and some soil sifts into the west side of the grain strips, there is a tendency for ridges of soil to accumulate over a period of years along the edges of the strips.

Mr. C. S. Noble, of Nobleford, Alberta, has recently proposed a modified strip-farming system, which he believes will overcome some of the difficulties. Instead of having the whole of the grain-growing area on the farm consisting uniformly of alternating strips of grain and fallow, permanently located, he divides it into fields solidly planted to grain, and other fields of what may be called "protected fallow." His fallowing operations he carried out about as follows:

The first operation takes place about May 1st, when he runs a one-way disc over the stubble, shallow and fast, cutting off the stubble and weeds and leaving them on the surface. Th second operation takes place about June 1st to 10th, after the weeds have well started. Now he uses the cultivator, beginning at the south-west corner of the field and running diagonally south-east and north-west (because in his part of the Province the prevailing wind is from the south-west). He follows behind the cultivator immediately with a seed-drill, sowing single 14-foot drill widths of wheat, with strips of fallow left between. The first two such strips of fallow are each about 5 rods wide, the next three about 10 rods wide, the next one about 15 rods wide, and the succeeding strips each about 20 rods wide, until he finishes at the opposite corner of the field. He uses an early wheat variety, and at least the first-sown strips in the south-west part of the field may mature. These are then harvested by a single cut of the combine to each strip. Those strips which do not mature may be cut for greenfeed. The third and last operation on the fallow is carried out with the rod weeder. The end of this implement may be allowed to kill the marginal row of wheat if necessary, to get all the weeds.

Next spring, the stubble on these drill-width strips is disked, and the whole field seeded solidly to wheat. The narrow strips of stubble do not affect the uniformity of growth and maturity of the succeeding crop as much as might be expected. Snow drifts off the fallow into the strips of stubble, thus supplying extra moisture and compensating partly for that removed by the crop. Thus while these narrow strips occurring at intervals in the field of solidly planted wheat may be a little shorter in the straw and mature a little earlier than the bulk of the crop, the differences are not enough to cause any inconvenience or loss in harvesting the whole field together.

Restricting the treatment of the fallow to the three operations just described does not result in complete control of weeds. Mr. Noble believes, however, that from the soil-drifting point of view it is preferable to allow a few weeds to escape rather than to run the risk of over-cultivation. This is a point which must be left to individual judgment. Where the danger of soil drifting is less acute it is certainly desirable to kill all the weeds.

There is one advantage to the modified method of strip farming proposed by Mr. Noble, which is of importance to farmers in central Alberta. That is, that the method can be applied immediately to the existing system of keeping grain and fallow in separate fields. It is not likely that under conditions where soil drifting is only an occasional problem rather than an almost annual affair, that strip farming in its original form will ever be widely adopted, since, as already noted, it involves laying out the whole grain-growing part of the farm in permanently located strips. But some modified form, which need not be carried on systematically year after year, should be very useful in many parts of the Province. Any fallow may be protected in the way proposed by Mr. Noble, in any season in which soil drifting is anticipated.

In addition to these specialized cropping systems, there are a number of preventive or control measures with which every farmer should be acquainted. They have been mentioned by previous speakers in this series, but cannot be emphasized too often.

The first principles to observe in handling fallows are to keep the stubble and trash on top and to keep the soil lumpy and ridged at right angles to the wind. Fall disking or cultivation of stubble is only useful on weedy land. If the land is moderately clean, it is preferable to leave the stubble undisturbed till spring, thus ensuring maximum protection and also holding more snow to contribute to the soil moisture.

Plowing, if it is done at all, should obviously be done in the spring ,unless some insect problem, such as the sawfly, is so acute as to make fall plowing essential. If the land is plowed, whether in fall or spring, special care must be taken in the subsequent tillage of the fallow, since now the stubble is buried and we must depend wholly on a lumpy and ridged surface to prevent drifting. The plowless fallow has a great advantage in keeping the stubble on or in the surface.

Working the fallow when the surface is moist after a good shower of rain will puddle it slightly, producing lumps which hold the soil in place. The spring after fallowing is a dan-

gerous time, if the weather is dry. In this case a cultivator with narrow teeth, or a spring-tooth harrow, run deeply and used while the moisture is still close to the surface, will bring up moist lumps which help to hold the soil till a crop can be established.

Drifting is most likely to begin on the tops of knolls, and it is very contagious. Protect such places by scattering over them the partially rotted straw from stack bottoms, or barnyard manure, or even by throwing up a few spaced furrows at right angles to the wind along the west side of such knolls or other places which show signs of beginning to drift.

In conclusion, let it be said that during dry years, or cycles of dry years, the soil-blowing problem should be kept in mind in connection with every operation carried out on the land. Since it is essentially a problem of the fallow, it is to the working of the fallow that the farmer must direct his most careful consideration. He need keep only two objects in view: (1) the control of weeds, (2) the control of soil blowing. These two objects are in a sense mutually antagonistic, since the tillage required for the control of weeds is a predisposing cause of soil drifting. However, by the adoption of a good cropping system, coupled with careful soil management and the use of special preventive and control measures as required, it is possible to accomplish both objects reasonably well. You have often been reminded of the proverbial wisdom of preparing in fair weather for the inevitable rainy day. Tonight I commend to you the equal wisdom of preparing for dry periods as well.

THE FARM NURSERY AND SHELTER BELT.

(No. 4 in a Symposium of Four Talks on Soil Drifting.)

By Clyde C. Gillies.

In the few minutes available this evening, it would be impossible to go into all the details concerning the planting and care of shelter belts. The information can readily be gotten from the Tree Planting Station, Indian Head, Saskatchewan, and is contained in a booklet called "Tree Planting on the Prairies of Manitoba, Saskatchewa, and Alberta." The author of this booklet, Mr. Norman Ross, has provided a wealth of reliable information dealing with varieties suitable to different areas, methods of propagation and culture, nursery practice and so on. No intending planter should be without this pub-

lication. On the campus of the University of Alberta will be found many varieties of trees and shrubs which amply demonstrate that our native tree growth can be supplemented with many other beautiful and useful trees. The Department of Horticulture at the University will be glad to assist you in meeting your planting problems. The Alberta Town Planning Commission is also at your service with advice as to how, when, and where to plant. The Dominion Experimental Stations have under test many different varieties, and a visit to the nearest station or an enquiry addressed to the Superintendent will be to your advantage. With so many agencies willing and able to help, the intending tree grower should have no difficulty in obtaining up to the minute information, and for that reason the writer is going to confine himself to a few points from his experience gained in following the instructions of the institutions mentioned.

As this talk is one of a series on soil drifting, it might reasonably be expected that some definite pronouncement as to the value of shelter belts as a soil drifting control measure is to be made. From observations made on the effect of native tree growth, it is seen that trees do provide effective shelter to crops and land in their vicinity from the ravages of wind. This protective range is limited and points out the necessity for concerted action. If tree planting, or in fact, most soil drifting control methods are confined to a few isolated areas, little good will be done. Concerted action on the part of the farmers must be taken if we are to control the soil drifting menace. The writer feels that while shelter belts will not entirely eliminate soil drifting, they are a strong factor in its control, and as there are so many other benefits to be derived from trees, the time and labor required in planting will be repaid in no small measure.

Trees and tree belts have many uses. They provide shelter for buildings, livestock, crops and roads. They beautify the countryside, provide shelter for and attract one of the farmers' greatest allies, birds. They prevent the rapid run-off of rain and melted snow, and by so doing tend to hold our lakes and rivers at more constant levels. Trees can be made to supply some of our future wood needs. Not only can fuel woods be grown, but woods of a quality that will provide material for fence posts, wagon tongues, and other farm needs.

In setting out shelter belts there are a few simple precautions to be taken if the maximum of efficiency is to be gained. In planting about the home and buildings, the trees should be far enough away to prevent snow from collecting in yards and

on roads. Ample space should be left to allow room for new buildings. Tree belts that are too wide or are in exposed positions are very apt to trap snow to an extent that will break down the young trees. An excellent plan is to plant a caragana hedge at least fifty feet from the tree belt and on the side from which the prevailing wind comes. In the Edmonton district, where our heaviest winds are from the northwest and southeast, this protection should be given from the north and east. If this procedure is followed in laying out shelter belts adjoining road allowances, much snow will be trapped before it has a chance to blow on to the road, and the maintainance of winter roads will be made much easier. Four or five rows of trees with the rows four feet apart and trees four feet apart in the rows, provides a good shelter belt. If the belt is in an exposed position, or in almost any case, it is a good plan to bind in the trees with a row of caragana down each side.

It would appear that the protecting space of fifty feet between the tree belt and the protecting caragana hedge is an unnecessary waste of land, but if we stop to consider, we will realize that this space is ideal for the growing of crops to which we wish to give a little extra care or which require the shelter which does not exist in the more exposed fields. It is easy to visualize years in which this area would greatly outyield the other areas of the farm.

It is the practice in laying out shelter belts to plant a mixture of slow growing and quick growing trees. Suitable slow growing trees are the green ash, the American elm and white spruce. Of the quick growing trees the Manitoba maple and the poplars are the best. It might be well to point out that the native black poplar is considered the best of all the poplars for shelter belt purposes. As the quick growing trees mature and the shelter belt becomes too dense, these are thinned out and can be used for fire wood. The slow growing trees supply a quality of wood suitable for some repairs and fence posts. It is thus seen that shelter belts or other plantations can be made to supply a revenue in cash or kind.

There are several sources from which trees suitable for shelter belt planting may be got. In some cases, young trees can be got from the native growth. In bringing in native trees, care should be taken to select them from an environment similar to that in which they are to be planted. Another point is that the younger the tree the more easily it is transplanted While the native jack pine is usually found in light, sandy soils, and is considered hard to transplant, the writer has found that seedlings of this variety can be transplanted into the

richer soils if care is taken. This variety should be considered for shelter belt planting, as it is probably the most drouth resistant of all the evergreens. Seedling trees of good quality can be purchased in quantity at reasonable prices from the nurserymen of the west. In purchasing trees it is well to buy them from a nursery where they have been grown under conditions as near as possible equalling those of your own farm.

Possibly the best source of supply is the farm nursery. It need not be of very great extent. The writer has growing in a plot about forty feet long and twenty feet wide nearly three thousand Manitoba maple seedlings and about two hundred poplar cuttings. In a seed bed four feet by eight feet are nearly one thousand Norway spruce seedlings. Unless a very extensive yearly programme is laid out, a small space will provide enough seedlings for a season's planting. The work involved is no more than that required for the seeding and cultivation of a vegetable garden of similar size. The plot, if situated near the house can be attended to in spare moments and will probably have the shelter the seedlings require. If there are no trees of the varieties you wish to grow bearing seed in your vicinity, your local seedsman will be able to put you in touch with collectors of tree seeds. Best results will be obtained from local supplies or from seeds grown under conditions similar to yours. The writer's experience has been that best results are obtained from home grown seedlings. This is not intended as any slight on trees bought from nurseries, as good results have also been obtained from them. It is obvious that trees subjected to the conditions existing when trees are shipped have not the same chance as the freshly dug and quickly planted home grown product. Another advantage of the home nursery is that there is readily available a supply of seedlings which can be planted when time permits and which do not arrive at a time when stress of other work necessitates their neglect. While nurseries supply material at a low cost, the home nursery supplies it with a smaller outlay of cash, and the grower will find that the handling of home grown stock will add to the interest and enjoyment of his work.

The details of planting and cultivating the home nursery have purposely been left out, as they are covered in Mr. Norman Ross's booklet, "Tree Planting on the Prairies."

The requirements for producing a successful shelter belt may be summed up as follows:

Appreciation on the part of the grower of the value of trees. Inclusion of tree planting as one of the farm's activities and considering it as important as the other farm projects.

A knowledge of the proper methods of planting and cultivation. A supply of good seedlings or cuttings of varieties suitable to the district. A start on a modest scale. Do not embark on a heavy programme until you learn proper methods and the time and labor required. Last, and most important of all, plant your trees in a deeply worked, well tilled, clean, summer-fallow.

A word to those who are on timbered lands and who are contemplating clearing the land to put it under the plow. Do you realize how fortunate you are in having your shelter belts already established? Do you know that in the earlier settled bush areas soil drifting became a problem as cultivation continues? Remember that it will take years to replace any trees destroyed, and in planning your clearing plan for protection. The tendency today is towards larger and larger implements, and we are losing sight of the fact that these large implements are being successfully used, on both this continent and in Europe, on fields of from forty to sixty acres. A quarter section divided into four equally sized fields and with shelter on all sides of the fields, requires a comparatively small area devoted to trees; and is a most effective way of providing some insurance against wind and drouth. Many of us in the treed areas sincerely regret that we ruthlessly cleared the trees to the fence lines, and realize that had we left adequate shelter, our shelter belt areas would have returned us handsome dividends.

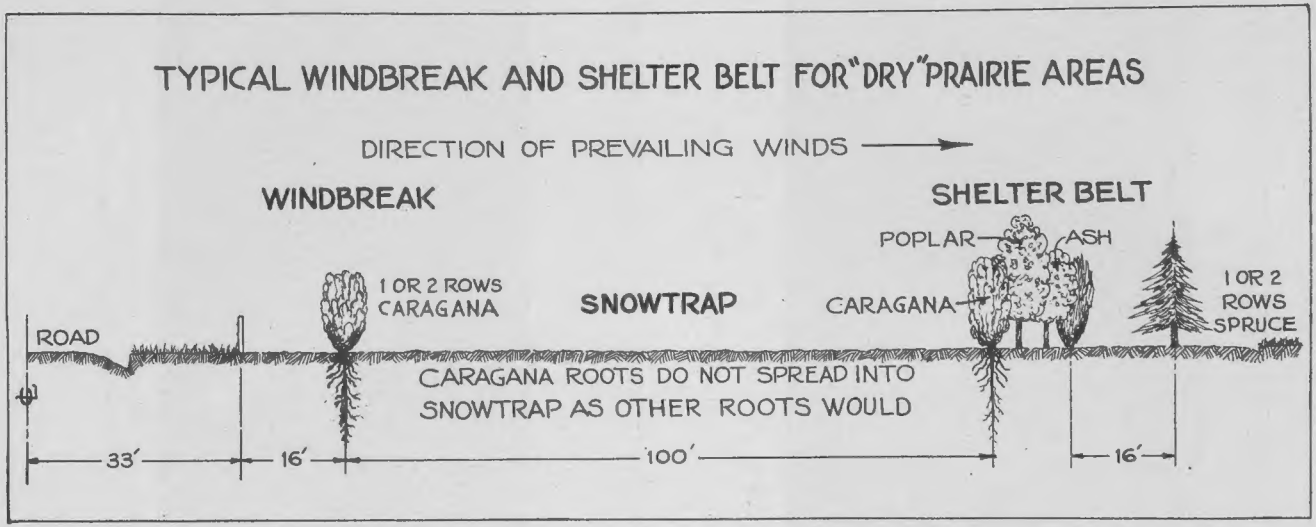
TYPICAL WINDBREAK AND SHELTER BELT FOR "DRY" PRAIRIE AREAS
DIRECTION OF PREVAILING WINDS
WINDBREAK
SHELTER BELT
POPLAR
ASH
1 OR 2 ROWS CARAGANA
SNOWTRAP
CARAGANA
1 OR 2 ROWS SPRUCE
ROAD
CARAGANA ROOTS DO NOT SPREAD INTO SNOWTRAP AS OTHER ROOTS WOULD
33'
16'
100'
16'

Plate V, Fig. 1.—Strip farming in the Monarch district.
By courtesy M. L. Freng.

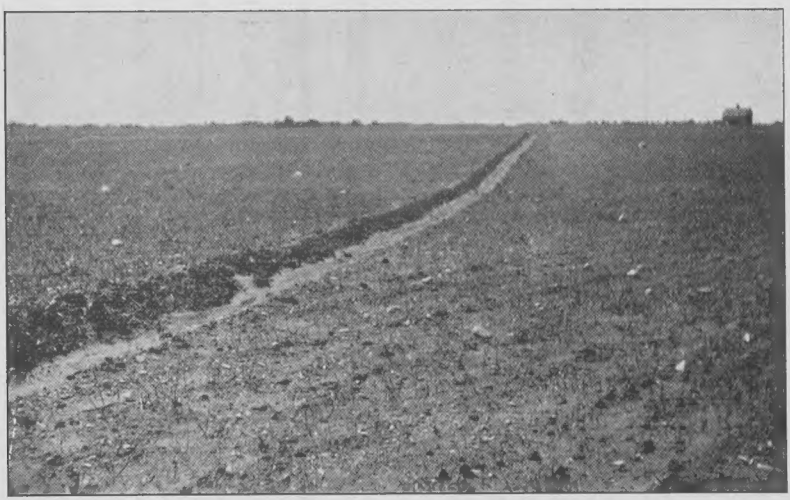

Plate V, Fig. 2.—Seedling crop protected by a furrow at right angles to prevailing wind.